PAPER 3:
ENSURING A SUSTAINABLE TROPICAL FRUIT INDUSTRY IN THE MIDST OF CLIMATE CHANGE: THE VIETNAM STORY

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ABSTRACT

Fruit production has been increasingly playing an important role in agricultural production in Vietnam. In 2016, the area of fruit trees in Vietnam reached 848 thousand hectares with an estimated productivity of over 8 million tons of fruit. Out of the fruit growing areas, the production in the North accounted for about 300,000 hectares, meanwhile the Southern provinces have occupied over 500,000 hectares. Major fruit trees cultivated under large areas include banana, citrus, longan, mango, dragon fruit, pineapple, durian, and rambutan. In the South, provinces along the Mekong River Delta are the main tropical fruit producers of the country with an area of approximately 300 thousand hectares that contributes to 36.5% of the national total fruit production. Vietnam is one of the countries that have suffered most from the effects of climate change, such as great impacts on agricultural production in Vietnam. In the provinces along the Mekong River Delta, salinity intrusion is increasing in terms of both land area and severity. More than 10,000 hectares of fruit trees have been salinated to various degrees. In order to adapt to climate change, the Vietnamese government is making changes in its investment policies for agricultural production. The nation is also concentrating on investing in breeding and selection of fruit tree varieties that are tolerant of drought, resistant to major diseases, and has salt-tolerant rootstocks. The breeders have successfully selected some of fruit varieties/cultivars of good salinity tolerance used for citrus production.

Keywords: Vietnam, exports, climate change impacts

INTRODUCTION

Vietnam has a diversified climatic condition, producing different fruit crops including temperate, tropical, and sub-tropical fruits. The leading fruits in Vietnam are longan, lychee, banana, pineapple, citrus, dragon fruit, mango, rambutan, and durian. The total land area utilized for fruit crop cultivation in Vietnam has reached over 848 thousand hectares. In addition, Vietnam's fruit and vegetable export values have increased rapidly in recent years, reaching USD 2.45 billion in 2016. However, Vietnam is listed as one of the countries that suffer the most from climate change. Annually, floods and droughts frequently occur in the northern and central provinces, and the Central Highlands. Salinisation of the Mekong River Delta has caused serious damage to fruit production and development, chiefly oranges, mandarins, lemon, and pomelo which were classified as relatively tolerant or sensitive to salinity. The current situation demands for solutions to maintain the fruit production under the context of climate change.

FRUIT PRODUCTION IN VIETNAM

Annually, the country produces over 8 million tonnes of fruit. Cultivation area of the major fruits account to three-fourth of the total production. Among the many kinds of fruit, banana takes up the largest production area of over 136 thousand hectares, yielding approximately 2.0 million tonnes per year. Citrus (orange and pomelo) is in the second place, with a total cultivation area of over 128 thousand hectares, with a production of 584.78 thousand tonnes of orange and 474.54 thousand tonnes of pomelo per year. Despite a smaller production area

of 44.0 thousand hectares, which is only half of mango's, dragon fruit yields almost 2.5 times higher than that of mango, which was 22.8 and 9.4 tonne/ha, respectively. Southern Vietnam is the main fruit granary of the country, producing various kinds of fruit — most of which are important fruits. Longans can be well cultivated in both the North and the South, while lychee production is available only in the northern provinces. Area and production of longan is 1.2–1.6 times higher than that of lychee.

Table 1. Production of major fruits in Vietnam

Kinds of Fruit	Total area (1,000 ha)	Yield (tonne/ha)	Production (1,000 tonnes)
Banana	136.48	16.2	1,968.71
Mango	84.77	9.4	707.89
Dragon fruit	44.00	22.8	817.80
Pineapple	40.91	16.3	579.98
Orange	72.08	12.4	594.78
Pomelo	54.75	11.7	474.54
Longan	73.94	7.8	504.99
Lychee	64.19	5.0	312.56
Rambutan	26.01	14.9	343.71
Durian	32.30	14.5	336.90
Others	219.21	-	> 1,300.00
Total	**848.64**		**> 8,000.00**

Along with an increase in cultivation area, the export turnover of fruit, vegetables, and flowers has increased from USD 23.1 million in 2000, which doubled in 2010 at USD 471 million, to USD 1.85 billion in 2015 and has currently peaked at USD 2.45 billion in 2016.

Dragon fruit is the leading fruit export in Vietnam. Its export turnover in 2010 reached USD 59 million, USD 483.4 million in 2015, and USD 800 million in 2016 which was one-third of the total export value of fruit, vegetables, and flowers. Many fruits produced in Vietnam including mango, banana, pineapple, pomelo, longan, litchi, and rambutan have been also accepted in numerous countries and territories.

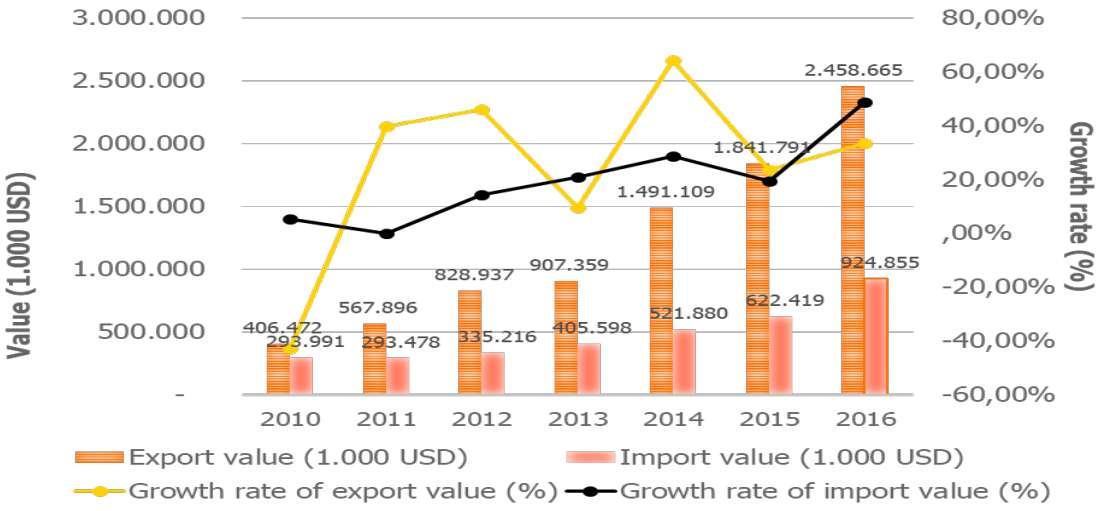

Figure 1: Export and import of fruit, vegetables and flowers in Vietnam (2010-2016)

Vietnam also imports various fruits from different countries in the world, which has seen an increasing trend, specifically since 2010. According to the Ministry of Agriculture and Rural development, Vietnam has recently paid almost half of the amount earned from exports of fruit, vegetables, and flowers for imports of produce. The growth rate of fruit, vegetable, and flower import even closely approached that of export in 2015, which was at 20%, and half as much as that in 2016 at 48.6% and 33.5%, respectively. Most of the imported fruit originates from China, Thailand, America, and Australia.

SALINITY INTRUSION IN MEKONG RIVER DELTA AND SOLUTIONS TO PROTECT FRUIT CROPS

Salinity intrusion in Mekong River Delta

Climate change has already impacted the Mekong River Delta, triggering an increase of sea water levels, annual rainfall amount and frequency, average temperature, and salt water intrusion to the mainland through the net-rivers of the Mekong River Delta. Normally, salinity intrusion appears in early February. The main reason for salinity intrusion is the inability of low upstream water to discharge salt water to the sea through rivers. Moreover, high tides combined with the effects of the northeast monsoon make the situation more severe. In addition, construction of dykes (dams) along the upstream Mekong riverbanks may also be the cause of increasing salt water intrusion. In recent years, it was observed that water levels in the upstream of the Mekong River is lower than the average water levels during dry seasons. This was acknowledged in previous years. Therefore, salt water intrusion has occurred earlier and has moved deeper inland, up to 40–50 km or more.

In fruit crops, the first symptoms of salt toxicity are yellowing and burning at the tip of the leaves which would eventually fall prematurely. In the Mekong River Delta, more than 10,000 hectares of fruit crops have been affected by salt water, including durian, rambutan, and citrus which are classified as relatively tolerant or sensitive to salinity. Salinisation has caused serious damage to the growth and development of fruit crops as well as the fruit production. Various measures such as reclamation, irrigation, and drainage have been used to reduce the salinity of the cultivation soil.

Solutions to protect fruit crops from salinity intrusion

In order to reduce damage of salt water intrusion in the Mekong River Delta, the local government has responded and applied measures to mitigate salt water intrusion as the region faces severe drought during the dry season. Those measures include:

- Pumping water from canals to recover crops along with dredging inland canals for faster and smoother water flow. However, salt water will likely penetrate into the canals soon.
- Building dams in order to prevent salt water intrusion. This measure is ineffective in the long term as hot weather causes the water to evaporate very quickly.
- Storing fresh water in large ponds and small canals in an orchard for months before cultivation. Nevertheless, the water will be insufficient and will run out early.
- Growing crops in areas close to dyke systems or where the water is slightly salty (under 4%) and with short duration of salt water intrusion.
- Growing salt tolerant crops such as coconut, mango, and sugar cane.

However, all the above solutions are only temporary. An overarching strategy for the whole region must be realized in order to cope with salt water intrusion. It is necessary for the Mekong River Delta to redesign cultivation schedules of crops for suitability with the annual intrusion of salt water to avoid its severe damage. Breeding clones/varieties of fruit crops which are tolerant/resistant to adverse environmental conditions is a sustainable measure which should be implemented in the future.

Study on citrus rootstocks for salt tolerance in Mekong River Delta

One recent strategy is to develop new crop cultivars/varieties which are tolerant to salinity. Screening of salt tolerant rootstocks for citrus in particular and other types of fruit crops is a major concern of countries affected by salinity.

Da Xanh pomelo is one of the major horticultural crops in the Mekong Delta and is relatively salt sensitive. Therefore, a study on the selection of the suitable grafted combinations of pomelo (*Citrus grandis* Osbeck) for salinity conditions in the Mekong Delta is necessary. A study on screening natural genetic resources for salt tolerant rootstocks was conducted from 2006–2012. Sixteen clones/varieties of local citrus were collected from the provinces of South Vietnam. Ten clones of citrus hybirds, *Cleopatra mandarin* and *Carrizo citrange* were used as salt tolerant and sensitive rootstocks. The objectives of the study were:

- To select a resistant citrus cultivar/variety as rootstock.
- Identify appropriate combinations of Da Xanh pomelo and rootstocks for salt tolerance, high yield, and fruit quality in saline conditions of the Mekong River Delta.

Results showed that salinity affected the growth and development of citrus clones/varieties and hybrid citrus clones. Salinity reduced chlorophyll content, starch content, and total sugar content while increasing the content of potassium, sodium, and chlorine in the leaves. Under net house conditions, 8 local citrus clones/varieties and hybrid citrus clones were identified as salt tolerant rootstocks such as Bong (Hue), Duong Hong pomelo (Binh Duong), Hong Duong pomelo (Can Tho), Bung pomelo (Ben Tre), Sanh (Ben Tre), Tac (Ben Tre), hybrid of Tac × Long Co Co pomelo, and hybrid of Tac × Da Xanh pomelo. The study suggested that methods for forecasting citrus rootstock-scion compatibility between citrus rootstocks and Da Xanh pomelo scion through ring grafting technique gave fast results and costs less. Five grafted citrus combinations between five salt tolerant rootstocks Bong (Hue), Duong Hong pomelo (Binh Duong), Hong Duong pomelo (Can Tho), Bung pomelo (Ben Tre), and Sanh (Ben Tre) gave good compatibility with Da Xanh pomelo scion under both net house and field conditions. Grafted citrus combinations grew and developed well. The combinations of the above rootstocks with Da Xanh pomelo gave good quality fruits. It is recommended to further evaluate the performance of the combinations to select the best scion-rootstock combination of vigorous growth, development, high yield, fruit quality stability, and good tolerance to saline environment.

Drought tolerance rootstocks for fruit crops in northern and central provinces

Similar to the South, adverse weather conditions have occurred in northern Vietnam with high frequency causing serious damage to the fruit production. Long rainy seasons and heavy storms caused floods to happen at a much higher frequency; long lasting dryness has caused severe drought in the central and central highland provinces; diseases occurring in fruit growing areas are more concentrated causing greater damage. Researchers have proposed various measures to deal with the problem. One of those is to study and develop rootstocks of good flood and drought tolerance. Practical productions revealed several fruit varieties of drought tolerance, especially of citrus. Major citrus varieties which have been used as rootstocks for drought tolerance include: Buoi Chua (sour pomelo), Buoi Do (Red pomelo), and Buoi Thanh Tra (Thanh Tra pomelo). Buoi Chua is the most widely used rootstocks for citrus production in the North. The variety exhibits vigorous growth and development, compatible with various stock varieties rapidly meeting demands for transplanting. However, the variety is of single-embryo and this may influence the stock performance; causing non-identical growth and development thus affecting fruit quality, disease resistance, and tolerance to adverse cultivation conditions.

CONCLUSION

Vietnam has a diversified climate condition, able to produce different fruit crops. The fruit and vegetable export turnover has seen an increase in recent years, contributing to the national agricultural export value. However, Vietnam is one of the countries suffering the most from climate change, causing great impacts on agriculture including fruit production. Floods, long droughts, and saline intrusion have occurred with a higher frequency, severely affecting the industry. The Government of Vietnam has currently established strategies to deal with climate change in future scenarios; gradually transforming the production towards promoting the use of varieties adaptable to drought and saline intrusion. There has been initial success in breeding fruit cultivars and rootstocks resistant to diseases, tolerant to drought and salinity for sustainable fruit production in climate change.